

TEPC Measurements on the Lunar Surface

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Tissue-equivalent proportional counters (TEPC) have served as "standard" area monitors against which other dosimeters are often compared. This was the case for the Space Shuttle and is the case for the ISS. TEPCs provide measurement of the lineal-energy distribution in a tissue, which converts to quantities of key relevance to human radiation protection, i.e., omni-directional tissue absorbed dose, dose-equivalent, and quality factor for all penetrating radiation types including neutrons. Hence, for the protection of astronauts on the Lunar surface, as well as for biological experiments designed to provide information in support of human missions to the Moon, a particularly useful radiation dosimeter would be a suitably designed TEPC.

TEPCs on Earth (e.g., the Hawk by Far West) and those designed for the ISS are large, power intensive, and tend to saturate at high dose rates such as those expected on the Moon during large SEP events. To make the TEPC technology suitable for missions beyond LEO, a compact, low-power version of this technology has been developed (Straume et al. 2015). The challenge was to develop a TEPC that could satisfy the small size and low power requirements while also provide reliable dosimetry for the complex radiation environment in space, which includes both steady-state galactic cosmic-ray (GCR) radiation and highly variable (and potentially very intense) SEP event radiation. Testing of the prototype has demonstrated proof-of-concept and that the technology can be advanced to flight TRL levels.

The TEPC is tissue-equivalent (TE) which means the energy absorption is equivalent to that expected in the tissues of an astronaut. Also, using a spherical sensor in the device (which is the case for our compact TEPC prototype) results in omni-directional response, which is what an astronaut would actually experience on the surface of the Moon, i.e., both incoming GCR and SEP event radiation and secondary albedo radiation (including neutrons) emanating from the lunar surface.

The compact prototype TEPC technology and test performance results will be presented and the pros and cons of TEPCs beyond LEO (and on the lunar surface) will be considered along with a broader discussion of TEPC comparisons to other radiation detection instruments used or planned for space.

Straume, T., L. A. Braby, T. B. Borak, T. Lusby, D. W. Warner, and D. Perez-Nunez (2015), Compact tissue-equivalent proportional counter for deep-space human missions, *Health Phys.*, 109, 277–283.